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Biological Report 82(11.30)
April 1985

TR EL-82-4

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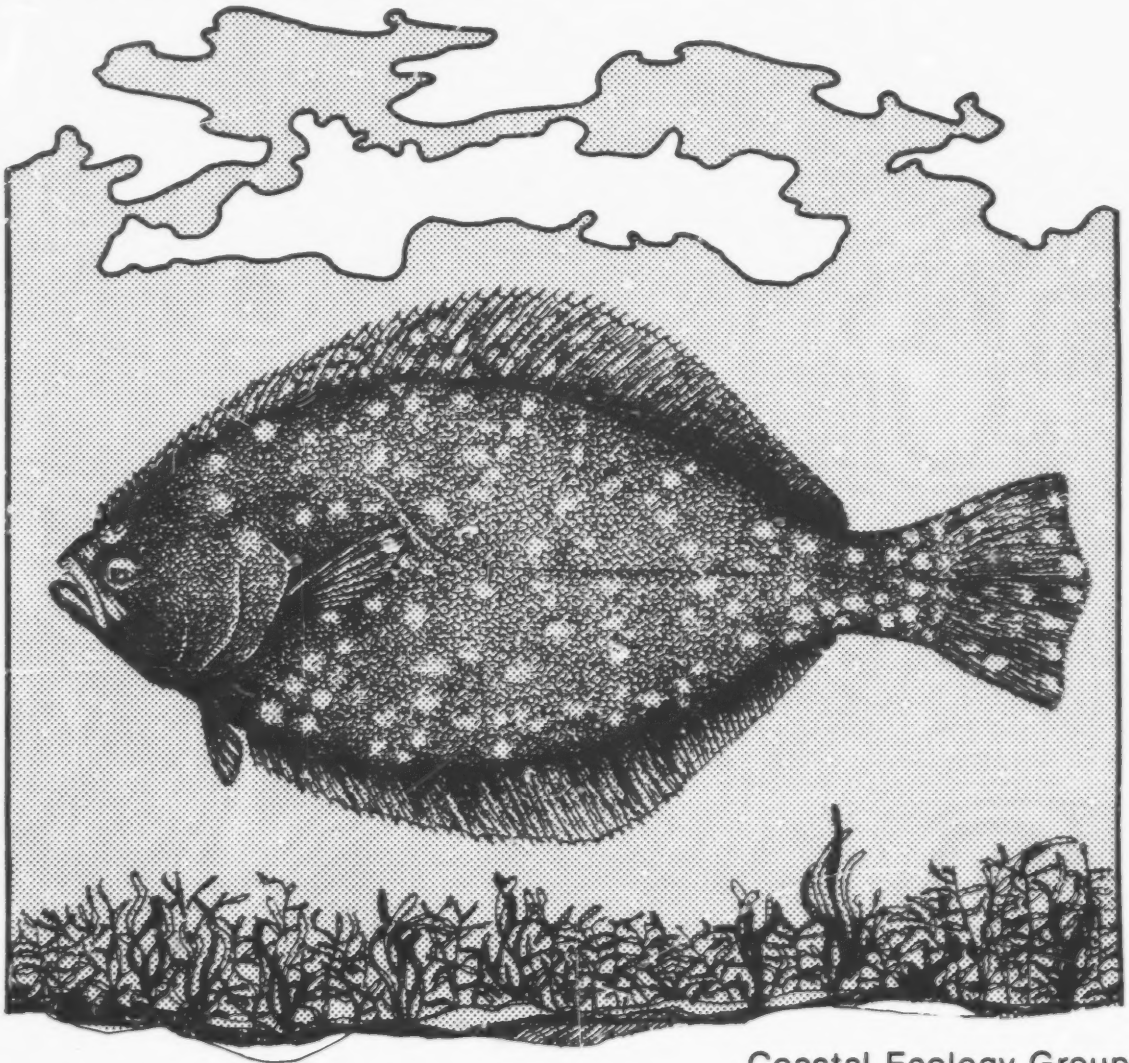
Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Gulf of Mexico)

ORIGINAL

SOUTHERN FLOUNDER



Fish and Wildlife Service
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This is one of the first reports to be published in the new "Biological Report" series. This technical report series, published by the Research and Development branch of the U.S. Fish and Wildlife Service, replaces the "FWS/OBS" series published from 1976 to September 1984. The Biological Report series is designed for the rapid publication of reports with an application orientation, and it continues the focus of the FWS/OBS series on resource management issues and fish and wildlife needs.

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Biological Report 82(11.30)
TR EL-82-4
April 1985

Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Gulf of Mexico)

SOUTHERN FLOUNDER

by

Roland E. Reagan, Jr.
and
William M. Wingo
Department of Wildlife and Fisheries
136 Dorman Hall
Mississippi State University
Mississippi State, MS 39762

Project Manager
Larry Shanks
Project Officer
John Parsons
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
1010 Gause Boulevard
Slidell, LA 70458

Performed for

Coastal Ecology Group
U.S. Army Corps of Engineers
Waterways Experiment Station
Vicksburg, MS 39180

and

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Division of Biological Services
Research and Development
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PREFACE

This species profile is one of a series on coastal aquatic organisms, principally fish, of sport, commercial, or ecological importance. The profiles are designed to provide coastal managers, engineers, and biologists with a brief comprehensive sketch of the biological characteristics and environmental requirements of the species and to describe how populations of the species may be expected to react to environmental changes caused by coastal development. Each profile has sections on taxonomy, life history, ecological role, environmental requirements, and economic importance, if applicable. A three-ring binder is used for this series so that new profiles can be added as they are prepared. This project is jointly planned and financed by the U.S. Army Corps of Engineers and the U.S. Fish and Wildlife Service.

Suggestions or questions regarding this report should be directed to one of the following addresses.

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Boulevard
Slidell, LA 70458

or

U.S. Army Engineer Waterways Experiment Station
Attention: WESER-C
Post Office Box 631
Vicksburg, MS 39180

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CONVERSION TABLE

Metric to U.S. Customary

Multiply	By	To Obtain
millimeters (mm)	0.03937	inches
centimeters (cm)	0.3937	inches
meters (m)	3.281	feet
kilometers (km)	0.6214	miles
square meters (m^2)	10.76	square feet
square kilometers (km^2)	0.3861	square miles
hectares (ha)	2.471	acres
liters (l)	0.2642	gallons
cubic meters (m^3)	35.31	cubic feet
cubic meters	0.0008110	acre-feet
milligrams (mg)	0.00003527	ounces
grams (g)	0.03527	ounces
kilograms (kg)	2.205	pounds
metric tons (t)	2205.0	pounds
metric tons	1.102	short tons
kilocalories (kcal)	3.968	British thermal units
Celsius degrees	1.8(°C) + 32	Fahrenheit degrees

U.S. Customary to Metric

inches	25.40	millimeters
inches	2.54	centimeters
feet (ft)	0.3048	meters
fathoms	1.829	meters
miles (mi)	1.609	kilometers
nautical miles (nmi)	1.852	kilometers
square feet (ft^2)	0.0929	square meters
acres	0.4047	hectares
square miles (mi^2)	2.590	square kilometers
gallons (gal)	3.785	liters
cubic feet (ft^3)	0.02831	cubic meters
acre-feet	1233.0	cubic meters
ounces (oz)	28.35	grams
pounds (lb)	0.4536	kilograms
short tons (ton)	0.9072	metric tons
British thermal units (Btu)	0.2520	kilocalories
Fahrenheit degrees	0.5556(°F - 32)	Celsius degrees

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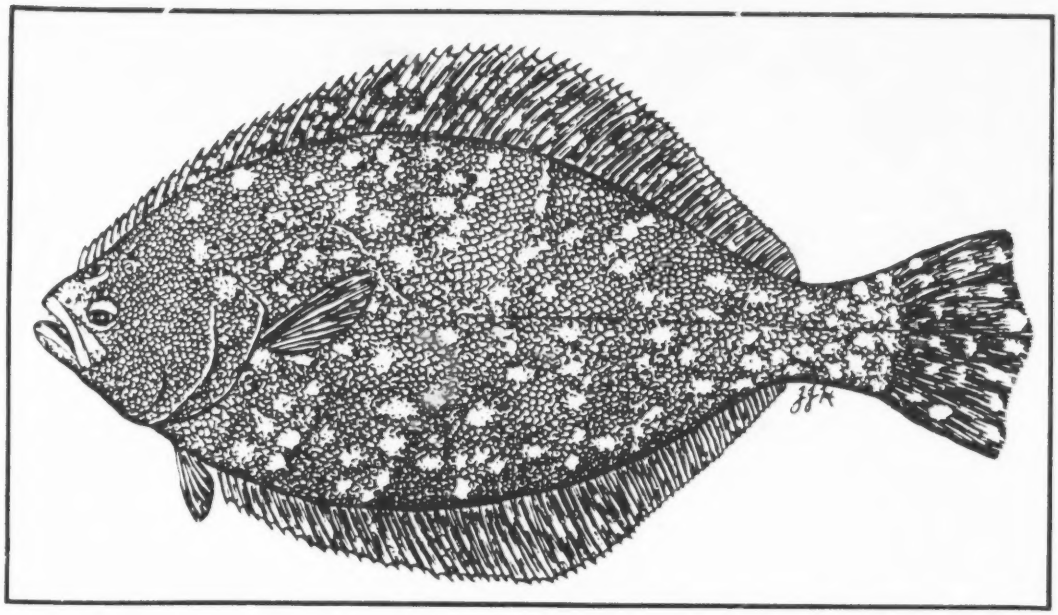

Figure 1. Southern flounder.

SOUTHERN FLOUNDER

NOMENCLATURE/TAXONOMY/RANGE

Scientific name ..... Paralichthys lethostigma (Jordan and Gilbert)
Preferred common name ..... Southern flounder (Figure 1).
Other common names .....Flounder, mud flounder, doormat, and halibut
Class ..... Osteichthyes
Order ..... Pleuronectiformes
Family ..... Bothidae

Geographic Range: The southern flounder inhabits the coastal waters of the east coast and the Gulf of Mexico (Figure 2) from North Carolina to Texas. They are common along the shores of bays, sounds, and lagoons in comparatively shallow waters and sometimes enter freshwater (Gutherz 1967).

MORPHOLOGY AND IDENTIFICATION AIDS

Dorsal fin rays range from 80 to 95; anal rays from 63 to 74, and pectoral fin (eye side) rays from 11 to 13. Upper gill rakers on the upper limb of the first gill arch range from 2 to 3 and lower gill rakers on the lower limb from 8 to 11. Scales in the lateral line range from 85 to 100. Body depth is 30% to 47% of standard length (SL). The eyes are on the left side and color is light to dark brown with diffuse nonocellated dark spots and blotches. The blindside

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Figure 2. Distribution of southern flounder in the Gulf of Mexico coastal region.

is white or dusky (Hoese and Moore 1977).

REASON FOR INCLUSION IN THE SERIES

The southern flounder is a valuable sport and commercial fish along the gulf coast. Sport fishing is done by hook and line and by gigging. Most of the commercial catch is incidental to the catch by shrimp trawlers. According to Jackson (1972) the southern flounder is "one of the most sought after and prized fish in the area and is recognized for its fine flavor."

LIFE HISTORY

Spawning

Most southern flounders spawn in late fall and early winter, but some spawn in early spring (Ginsburg 1952).

In North Carolina, southern flounders migrate out of estuaries in fall to spawn (Hildebrand and Cable 1930). In Texas, they migrate from estuaries into the Gulf of Mexico from October through December, apparently to spawn (Stokes 1977). Males move seaward earlier than females and few remain in the estuaries after November. This migration is usually preceded by a drop in water temperature of 4° to 5°C. Southern flounders are caught in gulf waters as deep as 63 m.

Females become sexually mature at 2 years of age in Texas (Stokes 1977). The youngest mature female southern flounder in northern Florida was 4 years old (Nall 1979). Of the mature females collected in August, 8% of the 4-year-olds, 5% of the 5-year-olds, and 18% of the 6-year-olds were developing eggs.

Southern flounders in Texas were induced to spawn in the laboratory (Arnold et al. 1977). About three weeks before spawning took place, males began following gravid females in the tanks. The first spawning was on December 21. Spawning was at midday, when females swam to the surface and released eggs that were immediately fertilized by attending males. Fertilization was 30% to 50% successful, and 6% to 35% of the eggs hatched in 61 to 76 hr (Arnold et al. 1977).

Fecundity

Thirteen southern flounders examined in the laboratory, produced a total of 120,000 eggs (average about 9,230; Arnold et al. 1977).

Larvae

In culture, yolk-sac larvae began metamorphosing to postlarvae at 40 to 46 days (8 to 11 mm long); metamorphosis was complete by 50 to 51 days (Arnold et al. 1977).

Juveniles and Adults

Postlarvae of southern flounder 18 to 34 mm in total length (TL) were captured during February, March, and May at Galveston Island, Texas (Arnold et al. 1960); fish 25 to 51 mm TL were caught in Mississippi River passes during spring (Kelley 1965).

Southern flounder postlarvae are caught along the Gulf of Mexico coast during winter and early spring. In Aransas Bay, Texas, the peak movement of postlarvae flounders into estuaries is in February, when water temperatures are between 16.0° and 16.2°C (Stokes 1977). In Texas, Breuer (1962) found postlarvae 35 to 50 mm TL in December.

Juveniles are generally collected during spring, summer, and early fall.

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Juveniles 50 to 100 mm TL were caught on the seaward beaches of islands in Louisiana in April (Gunter 1938), and fish 34 to 57 mm long were caught in marsh areas of the Mobile Delta during December and from February to April. Near the mouth of the Mississippi River, adults and juveniles were captured during summer in addition to a few adults taken in winter (Kelley 1965). Near Galveston Island, Texas, a single juvenile was captured in September (Arnold et al. 1960). Juveniles and adults were collected in the Mobile Delta in water of salinities ranging from 0 to 22.2 parts per thousand (ppt) (Swingle and Bland 1974).

From April 1974 to February 1975, adult southern flounders migrated in shallow waters from the Gulf of Mexico to Aransas Bay, Texas; the migrations were complete by late June (Stokes 1977). Adult flounders live in Texas bays from June through November, in water with abundant smooth cordgrass (Spartina alterniflora) (Stokes 1977).

GROWTH CHARACTERISTICS

A von Bertalanffy growth model for the southern flounder was also calculated by Nall (1979):

$$SL_t = 1.461\ [1-e^{0.0308\ t-(1-0.8629)}].$$

In this equation, SL_t is standard length (mm) at end of time period t and t is the time interval. This model predicted a maximum length (SL) of 1,461 mm, but the largest southern flounder reported in the literature was 762 mm (Ginsburg 1952). The model predicts a maximum age of 20 years.

Growth data on the southern flounder are available only from Florida and Mississippi. Annual growth increments in total length (to the nearest 1 mm) for southern flounder in Florida, based on scale measurements and analysis of 177 fish by age group and length (mm), were as follows: 0-I, 79; I-II, 70; II-III, 49; III-IV, 45; IV-V, 46; V-VI, 40; VI-VII, 37; VII-XIII, 34; and VIII-IX, 41 (Nall 1979). Except for ages VIII-IX, growth rate declined with an increase in ages.

In Florida the following total length ranges (to the nearest 1 mm) for each age were reported, I, 79; II, 80-142; III, 84-134; and IV, 170.0-215 (Nall 1979). In Mississippi, southern flounders were larger at the same age increment than in Florida: II, 230 mm; III, 340 mm; and IV, 480 mm (Etzold and Christmas 1979).

FISHERY

Most southern flounders caught for commercial sale in the Gulf of Mexico are taken by shrimp trawlers. All species of flounders caught in the Gulf, among which the southern flounder predominates, are combined in the commercial fishery statistics. Of the commercially landed flounders in Alabama, 95% were caught by shrimp trawlers and the remainder by gigging (Swingle 1976). The commercial landings of flounders in the Gulf States declined from 1971 to 1981 (Table 1). Landings in Alabama peaked in 1972 (1,169,800 lb) and generally decreased to 1981 (585,192 lb). Louisiana landings peaked in 1972 (507,300 lb) and decreased substantially to 1981 (136,962 lb). The landings in Mississippi decreased from 172,000 lb in 1971 to 28,615 lb in 1981.

Southern flounders are caught by sport fishermen along the entire northern Gulf of Mexico, but information on the fishery is available only for Alabama and Mississippi. In Mobile Bay and the nearby coastal waters, flounder fishing is most productive from piers (Wade 1977). The cost of daily fishing trips on fishing piers in 1977 ranged from $5.42 to $14.55. In 1969, in a 6-month period in Biloxi Bay, Missis-

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Table 1. Commercial landing (hundreds of pounds) and dockside value (hundreds of dollars) of flounders in five States, 1971-81[a].

Year	Florida		Texas		Alabama		Louisiana		Mississippi		Total	
	Weight	Value	Weight	Value	Weight	Value	Weight	Value	Weight	Value	Weight	Value
1971	296.5	76.9	319.1	75.6	950.8	154.6	463.4	77.4	172.0	23.4	2,201.8	408.0
1972	304.0	80.9	453.8	119.7	1,169.8	188.4	507.3	89.6	153.1	20.7	2,588.0	499.5
1973	263.2	79.2	341.9	105.2	709.0	136.2	281.4	55.5	97.2	16.5	1,692.7	392.7
1974	226.5	66.0	507.1	149.0	916.5	180.0	315.4	64.5	97.7	16.2	2,063.2	476.0
1975	219.3	68.5	492.6	176.0	832.0	174.3	242.5	62.3	104.8	22.5	1,891.2	503.8
1976	232.5	79.8	437.0	181.1	803.4	195.8	327.3	96.4	80.7	18.7	1,880.9	572.1
1977			310.9	171.5	598.5	163.2	292.5	102.4	81.4	23.4	1,283.3	460.7
1978			242.3	174.3	638.7	209.6	306.0	122.8	80.0	27.6	1,267.0	334.4
1979					671.2		195.3	271.6	53.5	86.1	920.2	357.7
1980					501.2		160.9	225.8	42.1	84.8	704.2	310.6
1981					585.1		136.9	304.3	28.6	87.6	750.7	391.9

[a] Information supplied by U.S. Department of Commerce, National Marine Fisheries Service, Southeast Fisheries Center, Miami, Florida.

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sippi, southern flounders contributed only 2.6% of the total sport catch. Catches were highest in October and November and lowest in September (Jackson 1972).

ECOLOGICAL ROLE

Food Habits

Small southern flounders eat a variety of invertebrates, but become piscivorous when they are about 200 mm long (TL). In Louisiana, adult southern flounders ate shrimp and fish (Reid et al. 1956). In a more detailed study in Louisiana, Fox and White (1969) reported that striped mullet (Mugil cephalus) was the major food item of southern flounders, followed by fat sleepers (Dormitator maculatus) and anchovies (Anchoa). The major foods (percent frequency of occurrence in stomachs) were as follows: striped mullet--57% in December-February; Anchoa sp.-- 30% in March-May; Callinectes sp.--6% in June-August; and fat sleeper--30%, Anchoa sp.--4%, Palaemonetes sp.--3%, and Penaeus sp.--3% in September-November. Fat sleepers appeared in the diet in October but disappeared in 2 to 3 weeks.

In Texas, Stokes (1977) reported that small flounders (10 to 150 mm long) ate mostly invertebrates (95%), among which mysids were the most common (32%). Larger flounders (150 mm long) ate primarily fish, among which anchovies, menhaden (Brevoortia sp.), sciaenids, and mullet (Mugil sp.) were most common.

Behavior

In a Louisiana study of day versus night trawling, 89% of southern flounders were caught at night, apparently because they are more vulnerable to trawling at night than during daylight (Dugas 1975). A tank study confirmed that flounders are more active at night (Dugas 1975).

A tag-recapture study of southern flounders in Texas revealed that movements between and within estuaries rarely exceeded 18 km (Stokes 1977). The time between release and recapture ranged from 3 to 212 days.

ENVIRONMENTAL REQUIREMENTS

Temperature

Temperature influences the migration of postlarval and adult southern flounders. Postlarval migration to estuaries from offshore waters peaked when water temperatures were about 16°C (Stokes 1977).

In Louisiana coastal waters, adult southern flounders have been collected at temperatures ranging from 5° to 35°C. In Lakes Pontchartrain and Maurepas, they were collected at water temperatures of 15.0° to 35°C from February through September (Tarver and Savoie 1976). In Louisiana, southern flounders were collected at temperatures of 5° to 35°C (Perret et al. 1971). In another Louisiana study, southern flounders were caught in waters with a temperature range of 10° to 30°C; most catches were made from May through August (Barrett et al. 1978).

Salinity

Adult southern flounders have been collected in waters with salinities of 0 to 36 ppt (Christmas and Waller 1973; Perret and Caillouet 1974; Tarver and Savoie 1976; Stokes 1977; Barrett et al. 1978). In Mississippi the largest catches of juveniles and young adults were at salinities of 15 to 20 ppt (Christmas and Waller 1973).

A study of the effect of salinity on survival and growth of early postlarval southern flounders showed that

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survival was not affected by salinities lower than 26 ppt (Deubler 1960). Growth, however, was faster at higher salinities. In North Carolina the older postlarvae grew faster in water of low salinity (Stickney and White 1973), although the differences in growth were not as clearcut as those of Deubler (1960). In Texas, older postlarvae may be more physiologically adapted to low salinities than younger postlarvae (Stokes 1977). Postlarvae were not collected in water of low salinities (10 to 12 ppt) until March.

Dissolved Oxygen

In a laboratory study, postlarval southern flounders attempted avoidance when dissolved oxygen concentrations fell below 3.7 mg/l. No avoidance differences were noted at temperatures of 6.1°, 14.4°, or 25.3°C (Deubler and Posner 1963).

Substrate

Southern flounders apparently show no preference for a particular type of bottom, though they rarely live on hard bottoms (Ginsburg 1952). In northeast Florida, Nall (1979) collected 152 flounders from mud bottoms and 25 from mud and sand bottoms, but none from hard bottoms. In Florida Bay, southern flounders were collected over shell and firm marl bottoms (Tabb and Manning 1961).

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Roland E. Reagan, Jr. and William M. Wingo

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MS Cooperative Fish and Wildlife Research Unit
P.O. Drawer BX
Mississippi State University
Mississippi State, MS 39762-5603

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16. Abstract (Limit: 200 words)
Species profiles are literature summaries of the taxonomy, morphology, range, life history and environmental requirements of coastal aquatic species. They are designed to assist in environmental impact assessment. Southern flounder is an estuarine dependent species and lives its entire life in or near estuaries. The southern flounder migrates out of the estuary into the Gulf of Mexico to spawn in October through February. Larvae and juveniles usually live in estuarine areas, but some juveniles live in nearshore areas in the Gulf of Mexico. The species has a maximum age of 10 years. Southern flounders are caught commercially by shrimp trawlers and a few are caught by gigging. Commercial landings (1971-81) have ranged from 1,169,800 to 28,615 lb. There are no data on sport catches of the species. Population dynamics data on the species are weak. Larval and juvenile flounders eat invertebrates. Adults eat a variety of fish and shrimp. Adult southern flounder have been caught in water with temperatures of 5° to 35°C. The species has been caught in water at salinities of 0-36 ppt. Southern flounder prefer mud bottoms over other types.

17. Document Analysis a. Descriptors
Estuaries
Growth
Fishes
Feeding

b. Identifiers/Open-Ended Terms
Southern Flounder
Paralichthys lethostigma
Temperature requirements
Life history
Spawning
Habitat requirements

c. COSATI Field/Group

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Lloyd Five Hundred Building, Suite 1692
500 N.E. Multnomah Street
Portland, Oregon 97232

REGION 2
Regional Director
U.S. Fish and Wildlife Service
P.O. Box 1306
Albuquerque, New Mexico 87103

REGION 3
Regional Director
U.S. Fish and Wildlife Service
Federal Building, Fort Snelling
Twin Cities, Minnesota 55111

REGION 4
Regional Director
U.S. Fish and Wildlife Service
Richard B. Russell Building
75 Spring Street, S.W.
Atlanta, Georgia 30303

REGION 5
Regional Director
U.S. Fish and Wildlife Service
One Gateway Center
Newton Corner, Massachusetts 02158

REGION 6
Regional Director
U.S. Fish and Wildlife Service
P.O. Box 25486
Denver Federal Center
Denver, Colorado 80225

REGION 7
Regional Director
U.S. Fish and Wildlife Service
1011 E. Tudor Road
Anchorage, Alaska 99503

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DEPARTMENT OF THE INTERIOR
U.S. FISH AND WILDLIFE SERVICE

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

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